Radioactivity 2

1.

Which type of radiation has the greatest ionising effect?

A α-particles

B β-particles

C γ-rays

D all have the same ionising effect

[1]

2.

A powder contains 400 mg of a radioactive material that emits α-particles.

The half-life of the material is 5 days.

What mass of that material remains after 10 days?

A 0 mg **B** 40 mg **C** 100 mg **D** 200 mg

[1]

3.

(a) Complete the following table about the particles in an atom. The first row has been filled in as an example.

particle	mass	charge	location
proton	1 unit	+1 unit	in the nucleus
neutron			
electron			

[6]

(b) **(i)** Which of the particles in the table make up an α-particle?

....

(ii) On the same scale as indicated by the table, state

1. the mass of an α-particle, ...

2. the charge of an α-particle. ....

[3]

4. When a nucleus of ${}^{90}_{38}X$ decays by beta radiation, it changes into a nucleus of an isotope of a different element Y.

(a) Explain the changes taking place in the nucleus when a beta particle is emitted.

(3 marks)

(b) Complete the nuclear equation given below for the beta decay of ${}^{90}_{38}X$.

$${}^{90}_{38}X \rightarrow {}^{-}_{-}Y \quad + \quad \beta$$

(2 marks)

5.

(a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

[1 mark]

....

(b)

When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.

$${}^{99}_{42}\mathrm{Mo} \longrightarrow {}^{99}_{43}\mathrm{Tc} + \text{Radiation}$$

What type of radiation is emitted by molybdenum-99?

[2 marks]

....

Give a reason for your answer.

....

....

(c) What is meant by the term 'half-life' in the context of a radioactive substance?

……………………………………………………………………………………………………….

……………………………………………………………………………………………………….

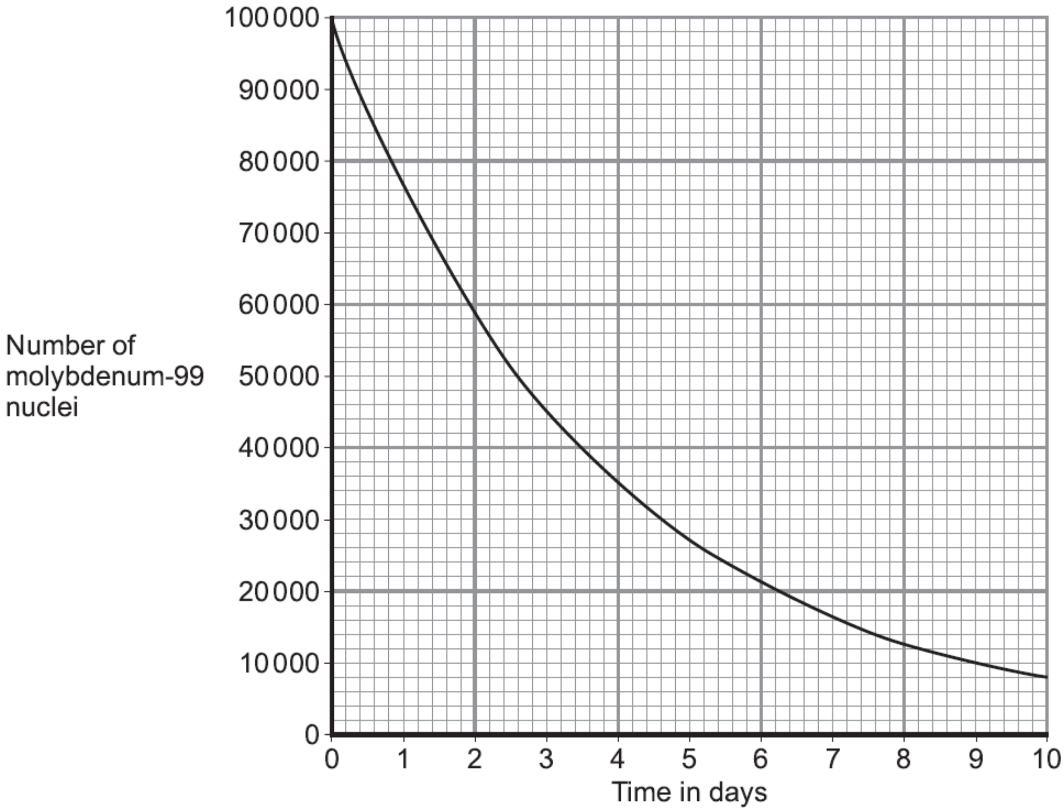
……………………………………………………………………………………………………….

[1 mark]

(d)

Figure 7 shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.

Figure 7



Use figure 7 to find the half-life of molybdenum-99.

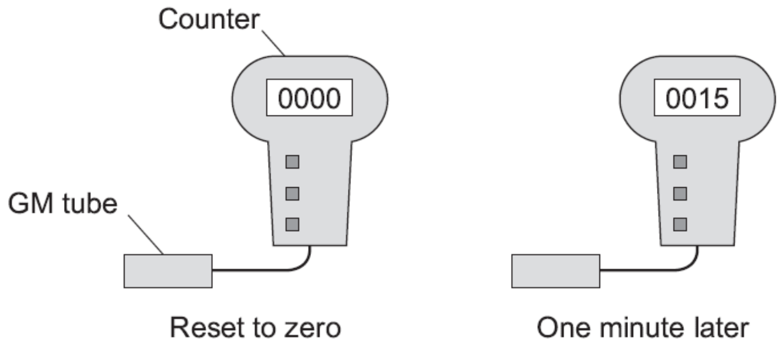
Half-life = ... days

(2 marks)

6.

(a) A teacher used a Geiger-Műller (GM) tube and counter to measure the *background radiation* in her laboratory.

The teacher reset the counter to zero, waited one minute and then took the count reading. The teacher repeated the procedure two more times.



(a) (i) Background radiation can be either from natural sources or from man-made sources.

Name **one man-made** source of background radiation.

....

(1 mark)

(a) (ii) The three readings taken by the teacher are given in the table.

Count after one minute
15
24
18

The readings given in the table are correct.

Why are the readings different?

....

....

(1 mark)

(b) Some scientists say they have found evidence to show that people living in areas of high natural background radiation are less likely to develop cancer than people living in similar areas with lower background radiation.

The evidence these scientists found does not definitely mean that the level of background radiation determines whether a person will develop cancer.

Suggest a reason why.

....

....

(1 mark)

(c) An atom of the isotope radon-222 emits an alpha particle and decays into an atom of polonium.

An alpha particle is the same as a helium nucleus. The symbol below represents an alpha particle.

$$^{4}_{2}\text{He}$$

(c) (i) How many protons and how many neutrons are there in an alpha particle?

Number of protons = ...

Number of neutrons = ...

(2 marks)

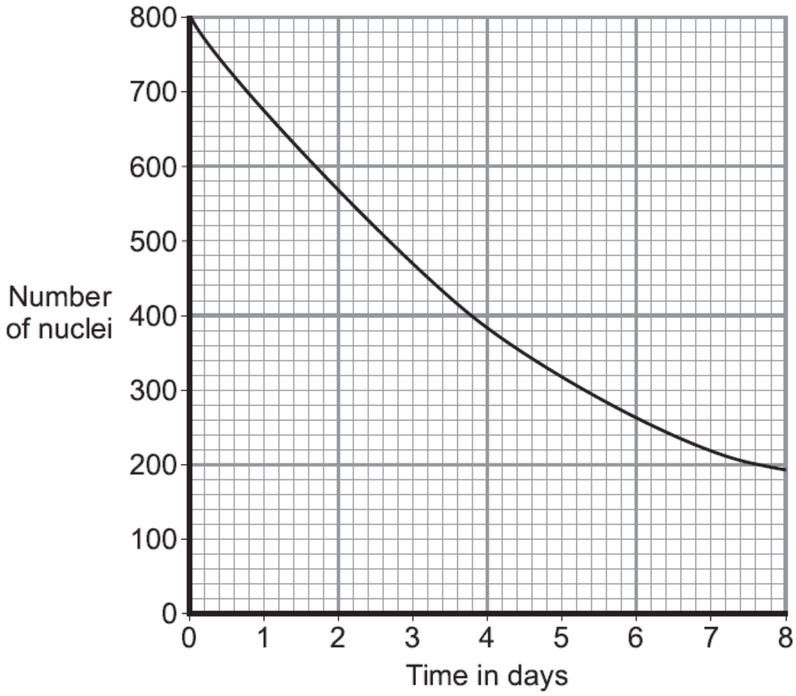
(c) (ii) The decay of radon-222 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.

$$^{222}_{86}\text{Rn} \longrightarrow \,^{\boxed{}}_{\boxed{}}\text{Po} + \text{alpha particle}$$

(2 marks)

(d) The graph shows how, in a sample of air, the number of radon-222 nuclei changes with time.



Use the graph to find the half-life of radon-222.

Show clearly on the graph how you obtain your answer.

Half-life = ... days

(2 marks)

7.

Fig. 10.1 is the decay curve for a radioactive isotope that emits only β-particles.

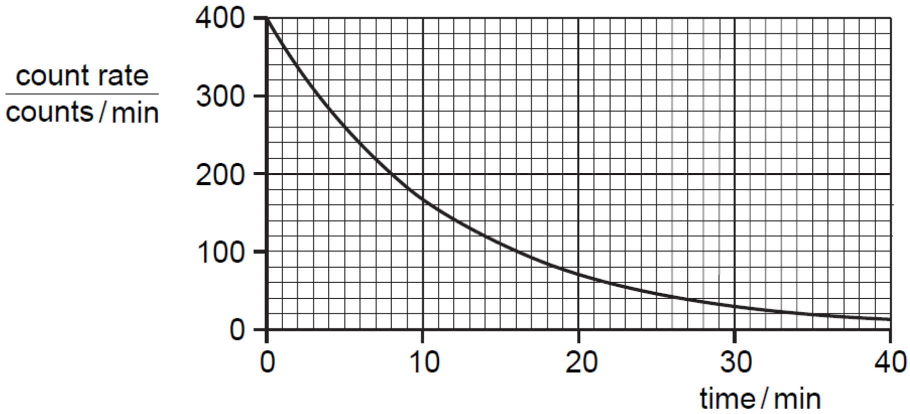


Fig. 10.1

Use the graph to find the value of the half-life of the isotope.

Indicate, on the graph, how you arrived at your value.

half-life .... [2]

8.

(a) The decay of a nucleus of radium $^{226}_{88}Ra$ leads to the emission of an α-particle and leaves behind a nucleus of radon (Rn).
In the space below, write an equation to show this decay. [2]

(b) In an experiment to find the range of α-particles in air, the apparatus in Fig. 11.1 was used.

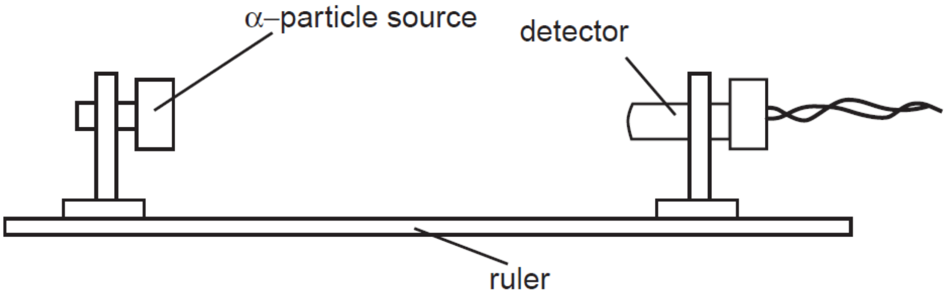


Fig. 11.1

The results of this experiment are shown below.

count rate / (counts/minute)	681	562	441	382	317	20	19	21	19
distance from source to detector/cm	1	2	3	4	5	6	7	8	9

(i) State what causes the count rate 9 cm from the source.

....

(ii) Estimate the count rate that is due to the source at a distance of 2 cm.

....

(iii) Suggest a value for the maximum distance that α-particles can travel from the source.

....

(iv) Justify your answer to **(iii)**.

....

....

[4]